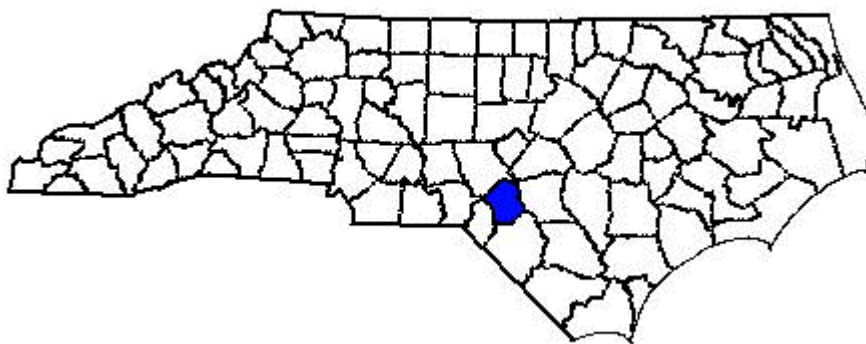


# ANNUAL REPORT FOR 2000



**LONG SWAMP MITIGATION SITE  
HOKE COUNTY  
PROJECT NO. 8.589008T  
TIP NO. R-512WM**



Prepared By:  
Natural Systems Unit & Roadside Environmental Unit  
North Carolina Department of Transportation  
December 2000

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## **LONG SWAMP MITIGATION SITE 2000 REPORT – EXECUTIVE SUMMARY**

The following report summarizes the monitoring activities that have occurred in the past year at the Long Swamp Mitigation Site. This site was constructed in 1998. Monitoring activities in 2000 represent the second year of monitoring following construction. The site must demonstrate hydrologic and vegetation success for a minimum of five years or until the project is deemed successful.

The site contains twenty groundwater monitoring gauges (five of which were installed this fall), one rain gauge, and eighteen vegetation plots.

This year, rainfall data has been acquired from two sources. From the beginning of the growing season to June, the daily rainfall on the gauge data graphs was recorded at a rain gauge in Red Springs (Robeson County), maintained by the NC State Climate Office. Since June, an infinity gauge installed on the site has provided local rainfall data.

Hydrologic monitoring indicated that the site is improving toward the goal of meeting the success criteria. Ten gauges met jurisdictional hydrologic success of at least 12.5% during the growing season; conversely, no gauges met hydrology less than 5% of the growing season and only two gauges were less than 8%.

All vegetation monitoring plots indicated an average tree density of over 320 trees per acres.

NCDOT recommends that the success criteria be revised to current standards. NCDOT will monitor the site for vegetation success for five years. A 320 stems per acre survival criterion for planted seedlings will be used to determine success for the first three years. The required survival criterion will decrease by 10% per year after the third year of vegetation monitoring (i.e., for an expected 290 stems per acre for year 4, and 260 stems per acre for year 5).

Based on the monitoring results from the 2000 growing season, NCDOT recommends that monitoring continue.

## 1.0 INTRODUCTION

### 1.1 Project Description

The Long Swamp Wetland Mitigation Site is located approximately 8.7 miles southwest of Raeford in Hoke County (Figure 1). It is bounded by SR 1105 (Wire Road) to the north, SR 1108 (Wilson Road), and SR 1115 (Tom McLaughlin Road) on the west, although portions of the site extends south and west of these secondary roads. The site, located at the head of Long Swamp stream, is characterized as nearly level, encompassing minimal slopes associated with floodplain boundaries of low-energy streams, rims of Carolina bays, and intermittent sand ridges. The area was converted into agricultural use.

The site encompasses approximately 249 acres and is designed as a mitigation site primarily for the US 74 Bypass of Rockingham and Hamlet, TIP Project R-512 (USACE Action ID No. 199301490).

### 1.2 Purpose

In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for a minimum of five years or until success criteria are fulfilled. Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for both hydrologic conditions and vegetation survival. The following report details the results of hydrologic and vegetative monitoring during 2000 at the Long Swamp Mitigation Site.

Activities in 2000 reflect the second year of monitoring following the construction. Included in this report are analyses of both hydrologic and vegetative monitoring results as well as local climate conditions throughout the growing season.

### 1.3 Project History

Summer 1998	Site Construction
March 1999	Installation of Monitoring Gauges
April 1999	Tree Planting
April 1999	Initial Vegetation Monitoring
March-November 1999	Hydrologic Monitoring (1 yr)
October 1999	Vegetation Monitoring (1 yr)
March-November 2000	Hydrologic Monitoring (2 yr)
September 2000	Vegetation Monitoring (2 yr)

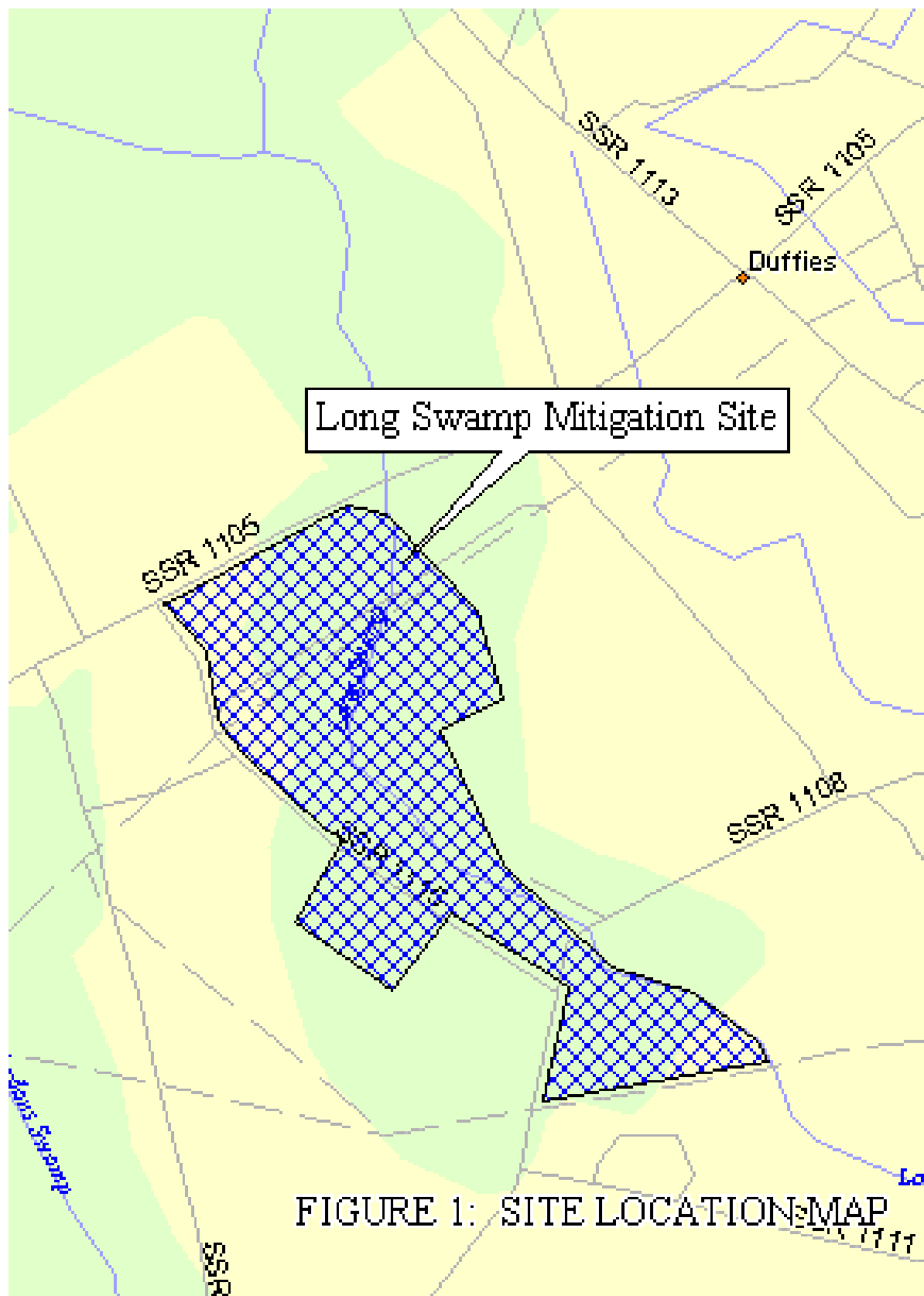


FIGURE 1: SITE LOCATION MAP

## **1.4 Permit Related Requirements**

Special Conditions of the permit applications for R-512, U-508, and R-2211 required that NCDOT:

- purchase or lease the site. The site was purchased in 1997.
- finalize the mitigation planning report for this site. The mitigation planning report was completed in 1997.

## **2.0 HYDROLOGY**

### **2.1 Success Criteria**

In accordance with federal guidelines for wetland mitigation, the success criteria for hydrology states that the area must be inundated or saturated (within 12" of the surface) by surface or ground water for at least 12.5% of the growing season. Areas inundated less than 5% of the growing season are always classified as non-wetlands. Areas inundated between 5% - 12.5% of the growing season can be classified as wetlands depending upon factors such as the presence of hydrophytic vegetation and hydric soils.

The growing season in Hoke County begins March 17 and ends November 12. The dates correspond to a 50% probability that temperatures will drop to 28° F or lower after March 17 and before November 12.<sup>1</sup> The growing season is 239 days; therefore the optimum duration for wetland hydrology is 30 days. Local climate must represent average conditions for the area.

### **2.2 Hydrologic Description**

Historically, wetlands on the tract were created by a combination of rainfall, runoff, and groundwater seepage from adjacent interstream areas, and redirected runoff via ditching. Local rainfall was contained within bays or was moved laterally to radially through the soil toward ditches or the remnant Long Swamp stream. After an extensive study of the site's hydrology, it was concluded that placement of impermeable plugs along drainage structures, backfilling of ditches and canals, and diversion of roadside ditches into restored wetlands would elevate the groundwater to a level that would saturate the soil stratum within the required twelve inches. It was predicted that this, in addition to surface water and runoff would be sufficient to restore wetland hydrology.

Fifteen groundwater monitoring gauges and one rain gauge were installed in 1999 (Figure 2). The automatic monitoring gauges record daily readings of groundwater depth.

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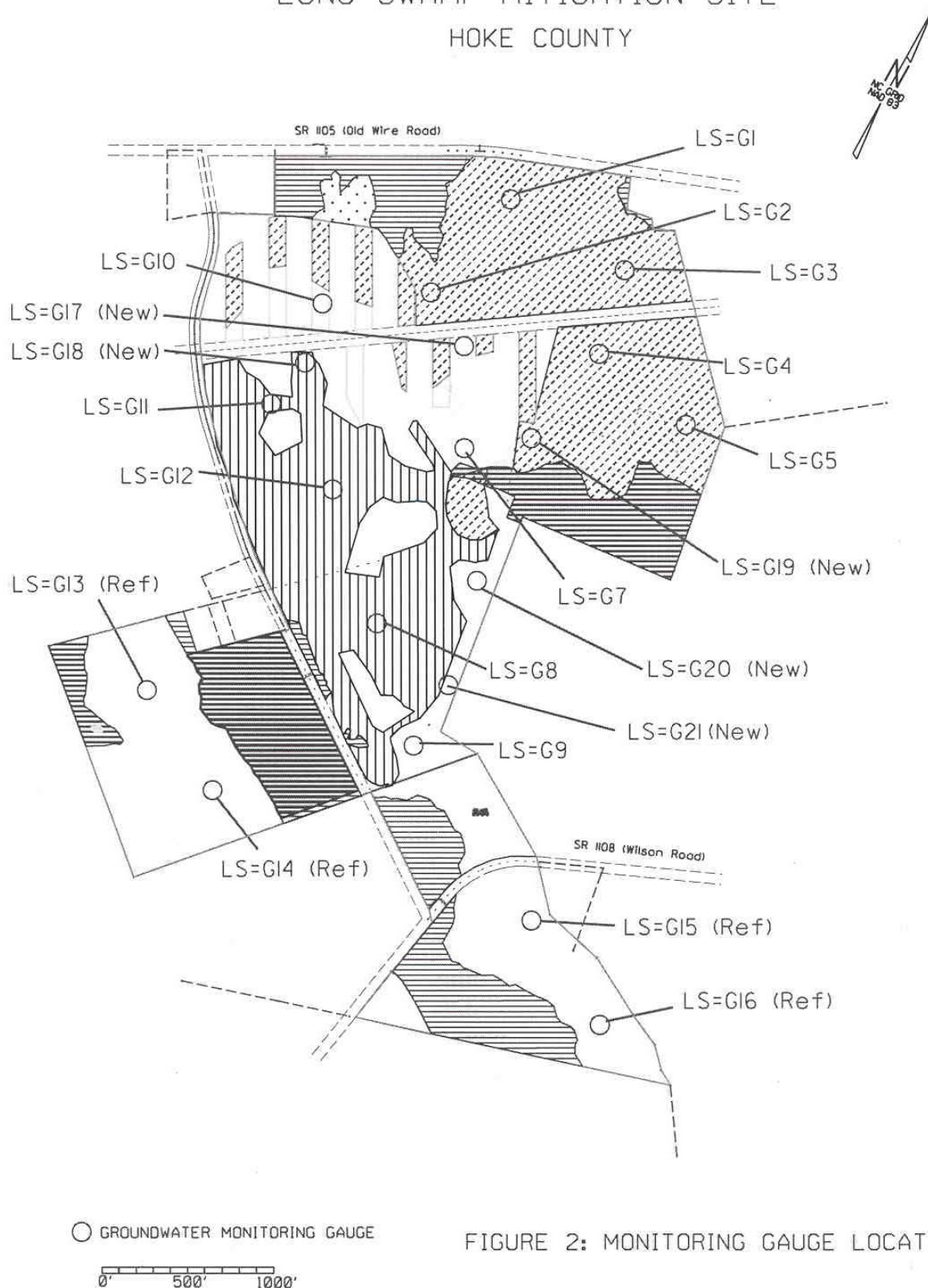
<sup>1</sup> Natural Resources Conservation Service, Soil Survey of Hoke County, North Carolina, p.105.

Five additional gauges (G-17 through G-21) were installed in November 2000 to provide more data in the restoration areas. These gauges were installed too late in the season to provide any data for this report.

The daily rainfall for the site is recorded from a combination of two sources. Prior to June, the average of the daily rainfall recorded by a rain gauge located in Red Springs was used; this rainfall data was provided by the NC State Climate Office. Since June, the rainfall data was acquired from a new onsite rain gauge.



# LONG SWAMP MITIGATION SITE HOKE COUNTY



## 2.3 Results of Hydrologic Monitoring

### 2.3.1 Site Data

The maximum number of consecutive days that the groundwater was within twelve inches of the surface was determined for each gauge. This number was converted into a percentage of the 239-day growing season. Table 1 presents the 2000 results. An asterisk \* in Table 1 denotes areas that are considered “reference wetland sites”, as was established in the mitigation planning report.

Appendix A contains a plot of the groundwater depth for each monitoring gauge. The maximum number of consecutive days is noted on each graph. Graph data determined to be erroneous was omitted; therefore, some gaps appear in the plots. Precipitation events are included on each graph as bars.

*Table 1*  
2000 HYDROLOGIC MONITORING RESULTS  
(MARCH 17 – NOVEMBER 12)

Monitoring Gauge	< 5% (<12 dy)	5 - 8% (12-18 dy)	8 - 12.5% (19-29 dy)	> 12.5% (>30 dy)	Actual %	Dates Meeting Success
LS-G1				✓	23.4	3/17 – 5/11
LS-G2		✓			7.5	9/19 – 10/6
LS-G3			✓		8.8	9/19 – 10/9
LS-G4		✓			5.9	9/23 – 10/6
LS-G5				✓	18.8	9/3 – 10/17
LS-G7			✓		11.3	9/19 – 10/15
LS-G8				✓	37.7	8/15 – 11/12
LS-G9				✓	29.7	9/3 – 11/12
LS-G10				✓	32.2	8/28 – 11/12
LS-G11				✓	32.2	8/28 – 11/12
LS-G12				✓	29.7	8/28 – 11/12
LS-G13*				✓	24.7	9/3 – 10/31
LS-G14*			✓		11.3	7/19 – 10/15
LS-G15*				✓	29.3	9/3 – 11/11
LS-G16*				✓	29.7	9/3 – 11/12

Figure 3 is a graphical representation of the hydrologic monitoring results for this year. A blue dot represents wetland hydrology for more than 12.5% of the season; a red dot indicates hydrology between 8% and 12.5%; a green dot represents hydrology between 5% and 8%. It is this hydrologic data that will indicate success for the site.

For this period from March to November, ten of the fifteen gauges met jurisdictional hydrologic success of at least 12.5% during the growing season. Conversely, no gauges met hydrology less than 5% of the growing season and only two gauges were less than 8%. These results are an improvement over the results from pre-hurricane conditions in 1999.

# LONG SWAMP MITIGATION SITE HOKE COUNTY

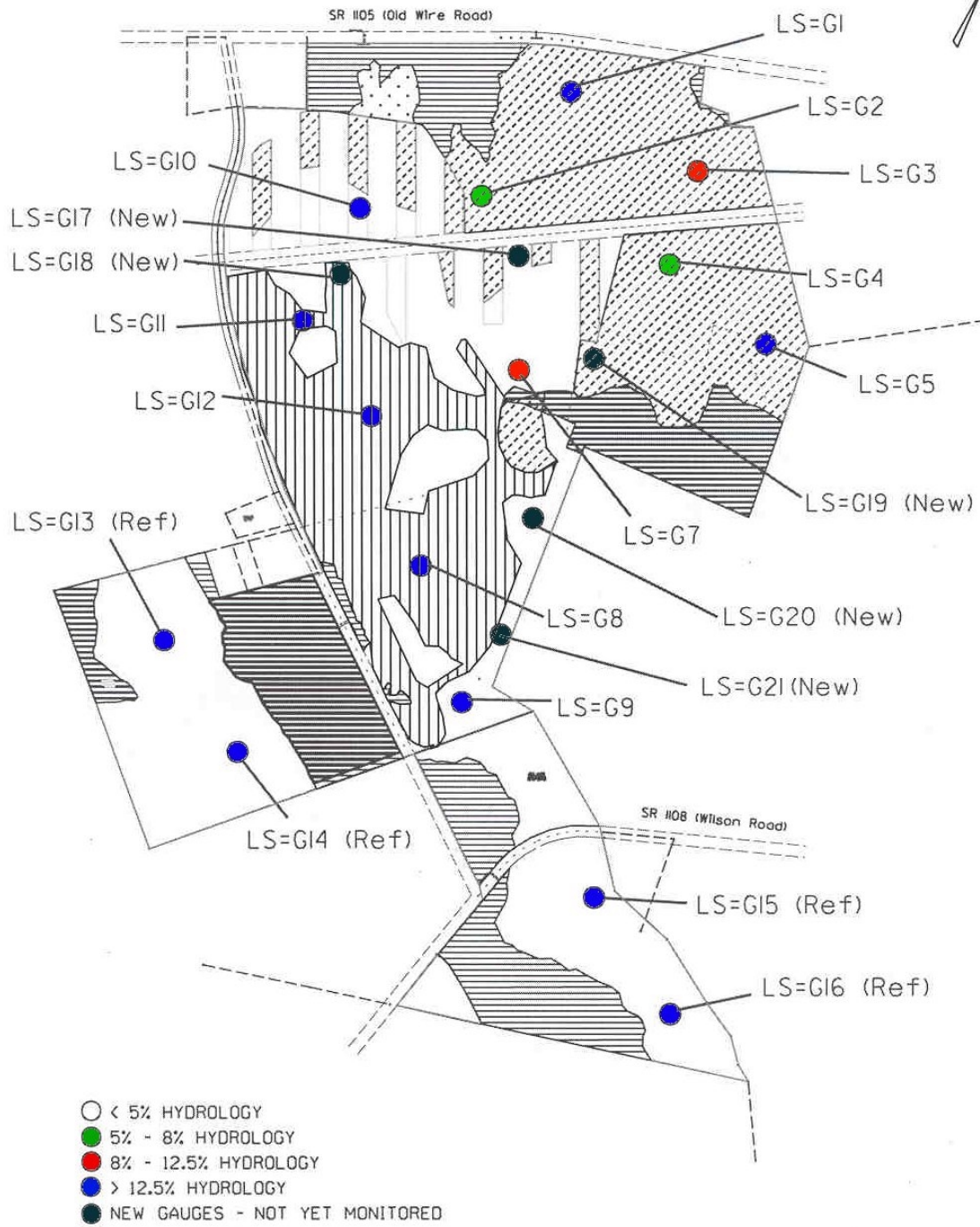


FIGURE 3: 2000 HYDROLOGIC RESULTS

### *2.3.2 Climatic Data*

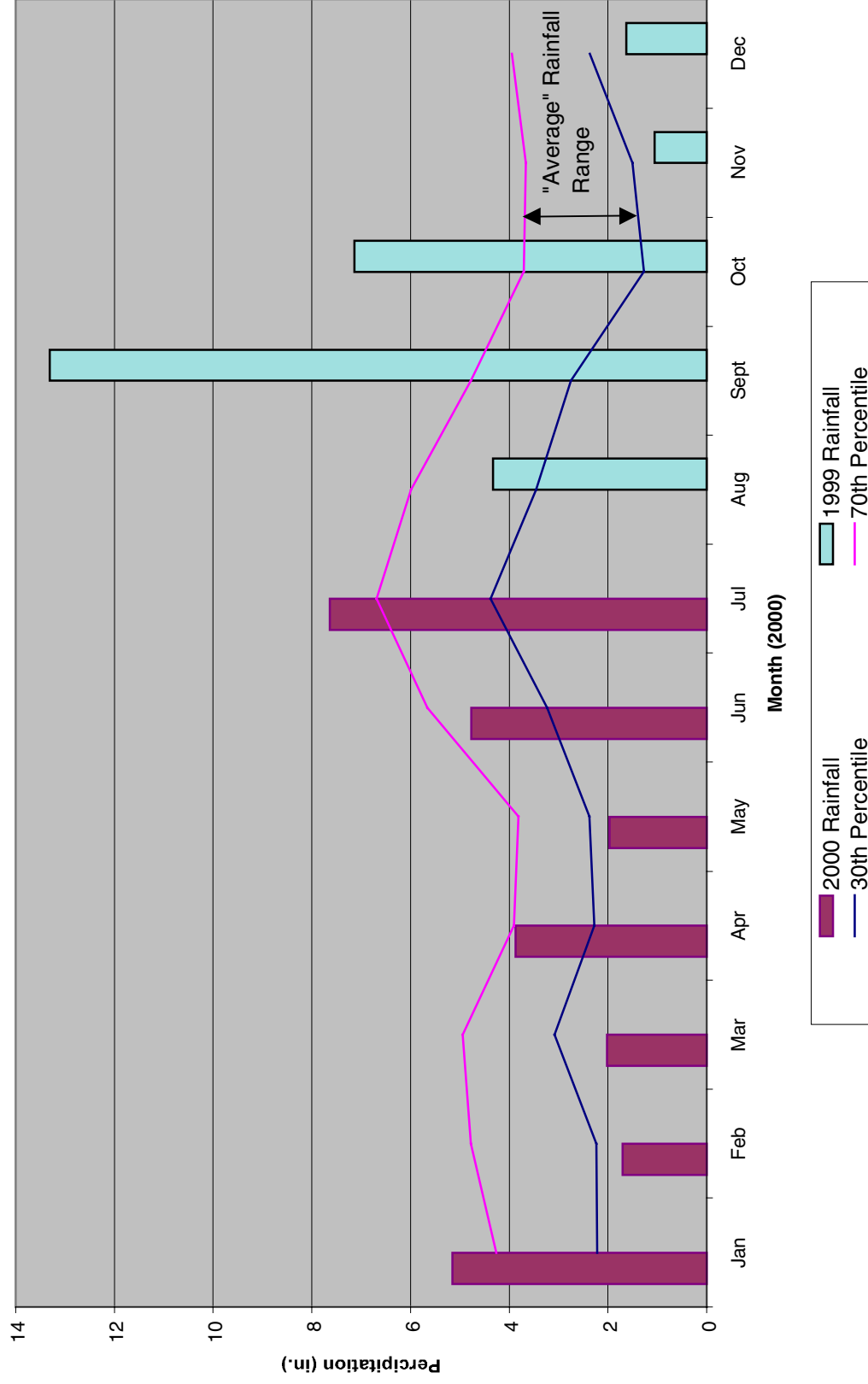
Figure 4 represents an examination of the local climate in comparison with historical data in order to determine whether 2000 was “average” in terms of climate conditions. The figure compares the rainfall from 2000 with that of historical rainfall (data collected between 1931 and 1999). All rainfall data was collected from the NC State Climate Office. The graph shows 1999 totals from September to December; the graph also shows 2000 rainfall totals through July 2000. Rainfall data for August through December 2000 will be presented in the 2001 Annual Monitoring Report.

For 1999, September and October had especially high precipitation due to hurricane activity, whereas November and December were below normal. For 2000, January and July were higher than normal, whereas, February, March and May were below normal. Overall so far, 2000 has been an average year in terms of precipitation.

## **2.4 Conclusions**

2000 represents the second full growing season that the hydrologic data has been examined. Ten of fifteen monitoring gauges met the jurisdictional wetland hydrology for 12.5% of the growing season. Since the hydrologic results are showing overall improvement to the site, NCDOT recommends that monitoring continue.

**FIGURE 4: Long Swamp 30-70 Percentile Graph  
Hoke County**



### **3.0 VEGETATION (YEAR 2 OF 5)**

#### **3.1 Success Criteria**

Success Criteria states that there must be a minimum of 320 trees per acre living for at least five consecutive years. A minimum of 5 character tree species must be present, with no more than 20% of any one species is also required with the exception of Atlantic White Cedar which may comprise up to 75% in swamp forest restoration. Loblolly Pine cannot comprise of more than 10% of the 320 trees per acre requirement.

#### **3.2 Description of Species**

The following species were planted in the Wetland Restoration Area:

##### **Zone 1: Streamhead Pocosin (2 acres)**

Taxodium distichum, Bald Cypress  
Chamaecyparis thyoides, Atlantic White Cedar  
Liriodendron tulipifera, Tulip Poplar  
Pinus serotina, Pond Pine  
Quercus laurifolia, Laurel Oak  
Fraxinus pennsylvanica, Green Ash  
Magnolia virginiana, Sweet Bay

##### **Zone 2: Streamhead Atlantic White Cedar (4.4 acres)**

Chamaecyparis thyoides, Atlantic White Cedar  
Liriodendron tulipifera, Tulip Poplar  
Pinus serotina, Pond Pine  
Fraxinus pennsylvanica, Green Ash  
Taxodium distichum, Bald Cypress

##### **Zone 3: Non-riverine Wet Hardwood Forest (74.4 acres)**

Quercus michauxii, Swamp Chestnut Oak  
Quercus laurifolia, Laurel Oak  
Quercus nigra, Water Oak  
Quercus lyrata, Overcup Oak  
Quercus phellos, Willow Oak

*Quercus falcata* var. *pagodaefolia*, Cherrybark Oak  
*Fraxinus pennsylvanica*, Green Ash

**Zone 4: Coastal Plain and Small Stream Swamp (42 acres)**

*Taxodium distichum*, Bald Cypress  
*Quercus phellos*, Willow Oak  
*Quercus laurifolia*, Laurel Oak  
*Quercus lyrata*, Overcup Oak  
*Quercus michauxii*, Swamp Chestnut Oak  
*Liriodendron tulipifera*, Tulip Poplar  
*Fraxinus pennsylvanica*, Green Ash  
*Nyssa sylvatica*, Blackgum

**Zone 5: Mesic Mixed Hardwood Forest (Coastal PlainSubtype)  
(43.8 acres)**

*Quercus lyrata*, Overcup Oak  
*Quercus alba*, White Oak  
*Quercus rubra*, Northern Red Oak  
*Quercus nigra*, Water Oak  
*Quercus falcata* var. *pagodaefolia*, Cherrybark Oak  
*Quercus michauxii*, Swamp Chestnut Oak

### 3.3 Results of Vegetation Monitoring

*Table 2*  
2000 VEGETATIVE MONITORING RESULTS

	Plot #	Overcup Oak	White Oak	Red Oak	Water Oak	Swamp Chestnut Oak	Cherrybark Oak	Willow Oak	Laurel Oak	Green Ash	Atlantic White Cedar	Pond Pine	Black Gum	Bald Cypress	Tulip Poplar	Sweet Bay	Total (year)	Total (at planting)	Density (Trees/Acre)
Zone 1	9	8				2	5	2	1			3	2				23	48	326
ZONE 1 AVERAGE DENSITY																			326
Zone 2	5	2			8				1		9	17					37	37	680
ZONE 2 AVERAGE DENSITY																			680
Zone 3	2	1					1	14	5								21	30	476
	3			1		14	4	11	2								32	35	622
	4	1		1		4	9		13	2							30	32	638
	6	3				7	2	3		11							26	26	680
	7	10		4		6	3		3	5							31	40	527
	17	2			2	10	1	6	7	7							35	45	529
	18	6				8		1		1							16	26	418
ZONE 3 AVERAGE DENSITY																			556
Zone 4	10					4		2	1	4			12	5			28	35	544
	11	6				8	1	5		4			3	6			33	37	606
	12	4				6							12	15			37	38	662
	13					9				2			8	5	3		27	31	592
ZONE 4 AVERAGE DENSITY																			601
Zone 5	1	3		3		15	10		1								32	38	573
	8		1	1		6	11	2	3	1							25	40	425
	14					12	5	1	11								29	29	680
	15			9		14	9	1	2								35	39	610
	16	16	4	1		1	15		7								44	45	665
ZONE 5 AVERAGE DENSITY																			591
TOTAL AVERAGE DENSITY																			570

To determine tree density, 50' x 50' plots are installed immediately following planting. The actual number of planted trees which occur within the plot are counted. This number is equated to the number within each plot, which represents 680 trees per acre (average). The survival monitoring number is compared to the planted number to obtain survival percentage. This percentage is applied to the 680 trees per acre to obtain an estimated tree per acre for the site. (Density = monitoring count/planted trees x 680)



Site Notes:

Zone 1	Other species: Sumac, grape vine, broom sedge, magnolia, holly, red maple and sweet gum. Cut over looks pretty clean.
Zone 2	Other species: Briars, wax myrtle, sumac, water oak, various grasses & sedges.
Zone 3	Other species: Sicklepod, various grasses, bermuda, broom sedge, morning glory, wetland fern wax myrtle, sumac, fennel, baccharis, crab grass, sweet bay, switch grass, grape vine and sweet gum.
Zone 4	Other species: Broom sedge, green briar, sweetbay, sumac, grape vine, goldenrod, baccharis, few sweet gum, few maple, gum, tulip poplar and holly.
Zone 5	Other species: Heavy sicklepod, broomsedge, bermuda, wire grass, horse nettle, morning glory.

Majority of the site is wet. Cut over areas look pretty clean. Trees are in excellent condition.

### 3.4 Conclusions

Of the 249 acres on this site, approximately 167 involve tree planting. There were 18 plots established throughout the planting areas, encompassing all plant communities. The vegetation monitoring resulted in an average density of 570 trees per acre with each zone passing the 320 trees per acre.

NCDOT recommends that the success criteria be revised to current standards. NCDOT will monitor the site for five years. A 320 stems per acre survival criterion for planted seedlings will be used to determine success for the first three years. The required survival criterion will decrease by 10% per year after the third year of vegetation monitoring (i.e., for an expected 290 stems per acre for year 4, and 260 stems per acre for year 5).

## **4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS**

The site has shown hydrologic improvement over the previous year. All vegetation monitoring plots indicated an average tree density of over 320 trees per acres.

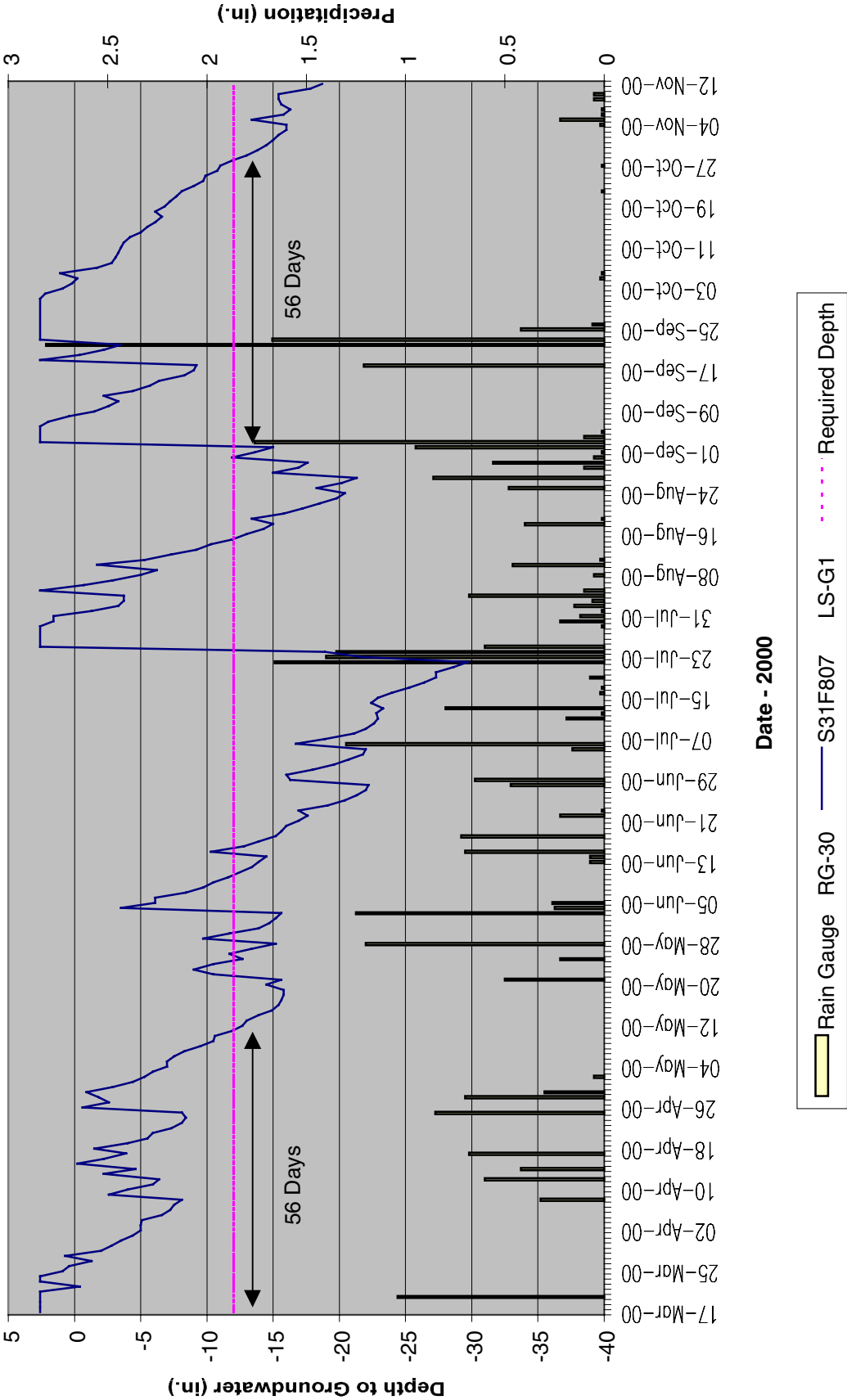
NCDOT will continue to monitor the site for hydrologic success.

NCDOT recommends that the success criteria be revised to current standards. NCDOT will monitor the site for vegetation success for five years. A 320 stems per acre survival criterion for planted seedlings will be used to determine success for the first three years. The required survival criterion will decrease by 10% per year after the third year of vegetation monitoring (i.e., for an expected 290 stems per acre for year 4, and 260 stems per acre for year 5).

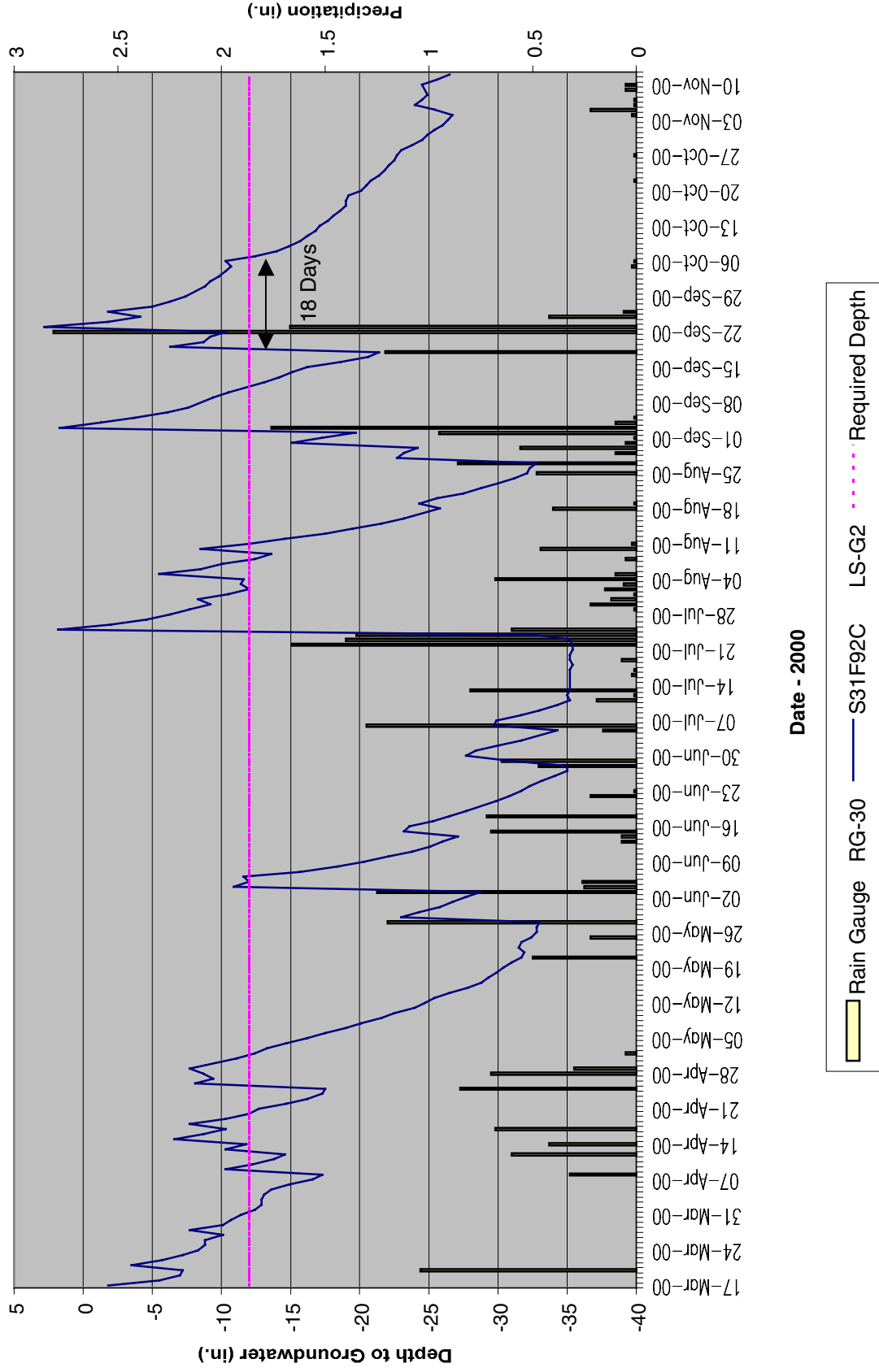
## **APPENDIX A**

### **DEPTH TO GROUNDWATER PLOTS**

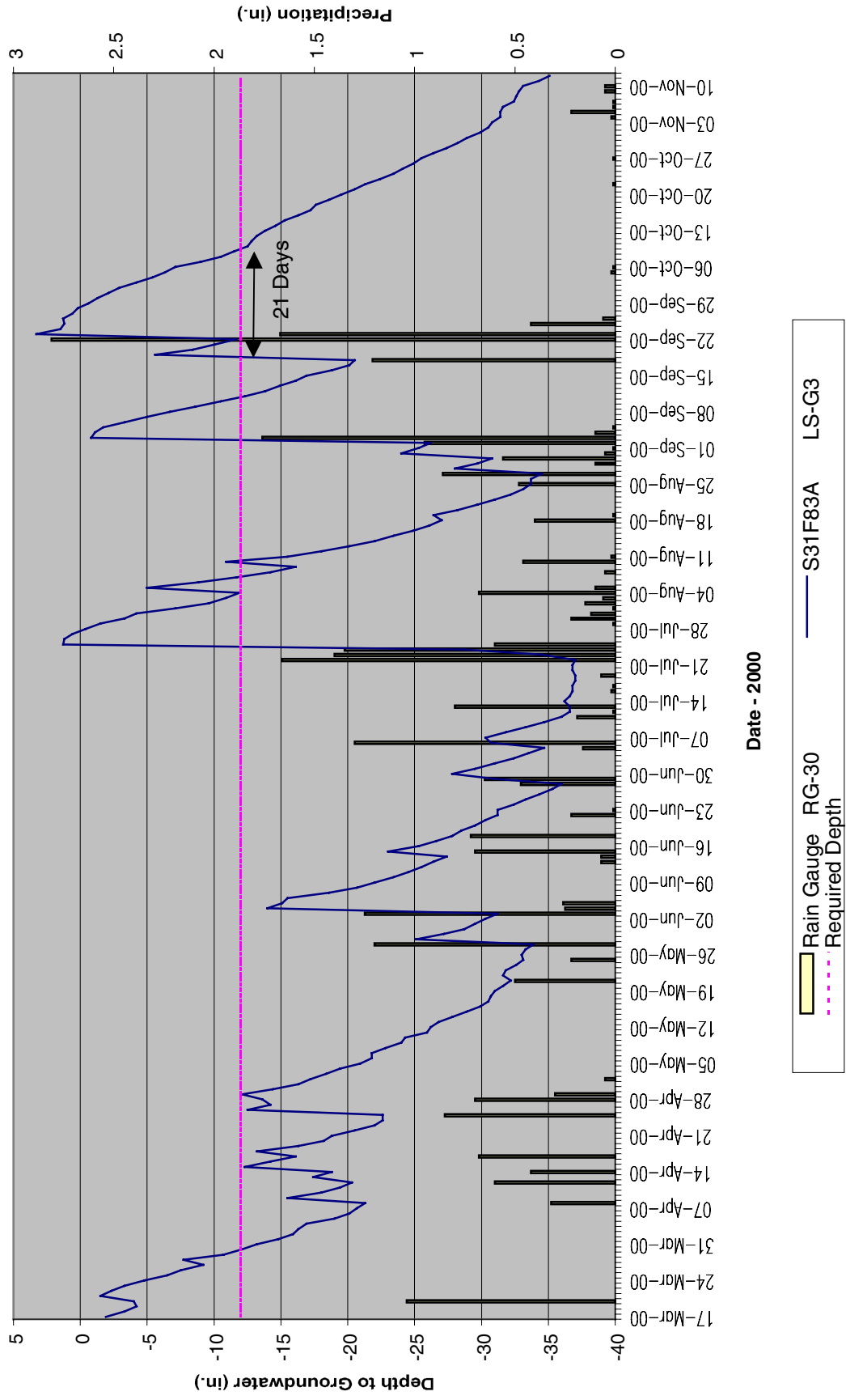
Long Swamp - Gauge G1



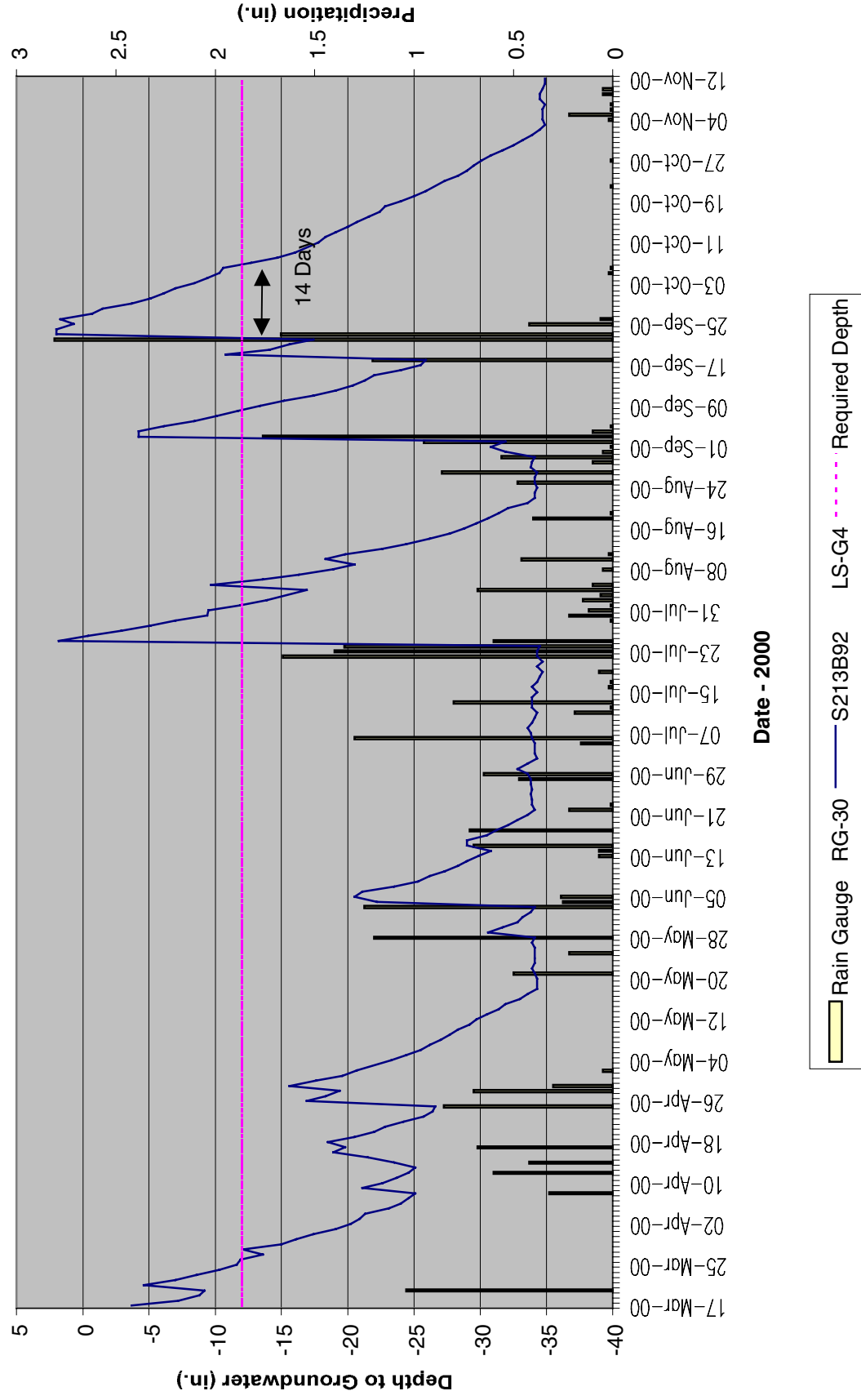
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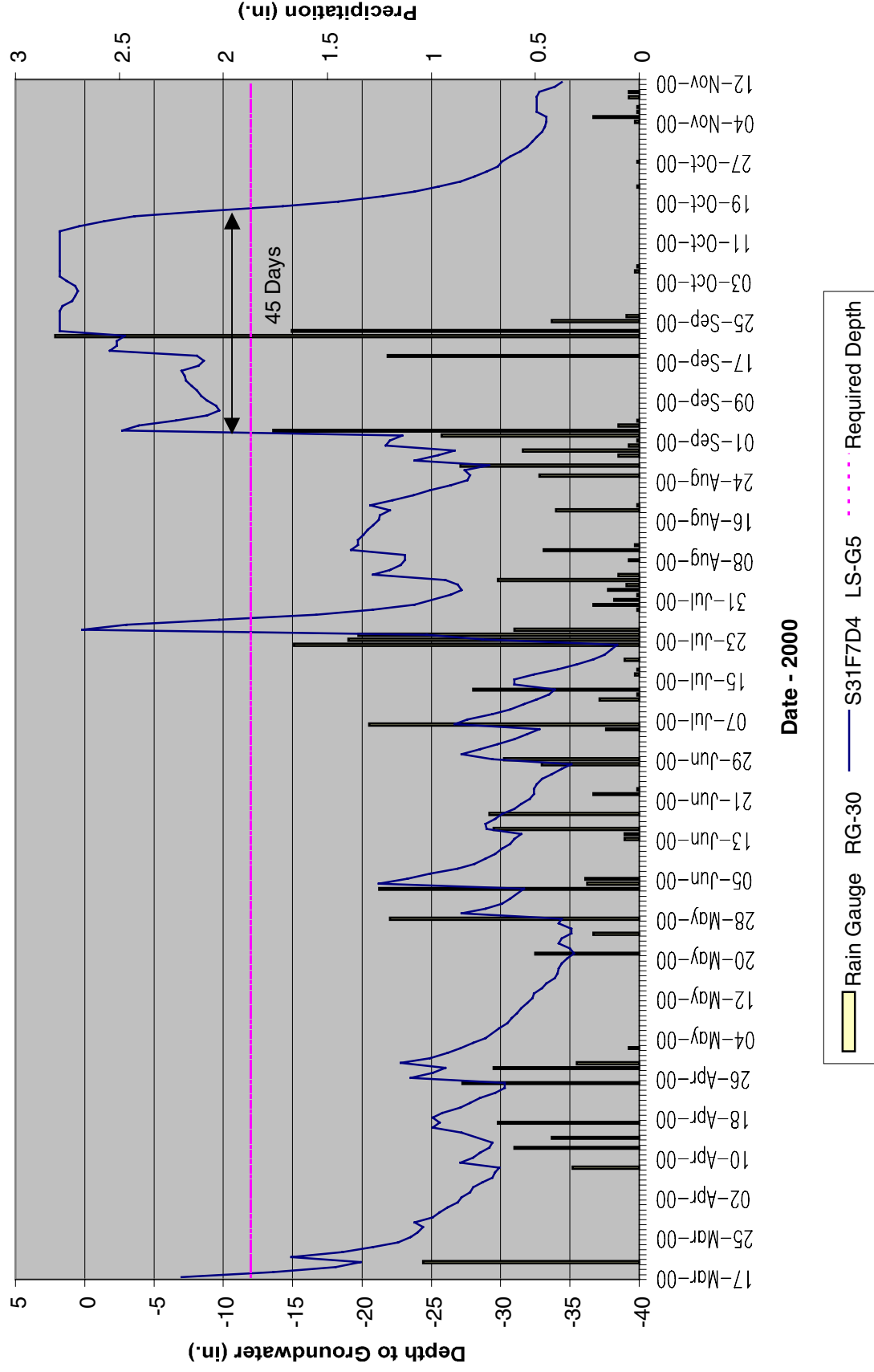
# Long Swamp - Gauge G3



# Long Swamp - Gauge G4

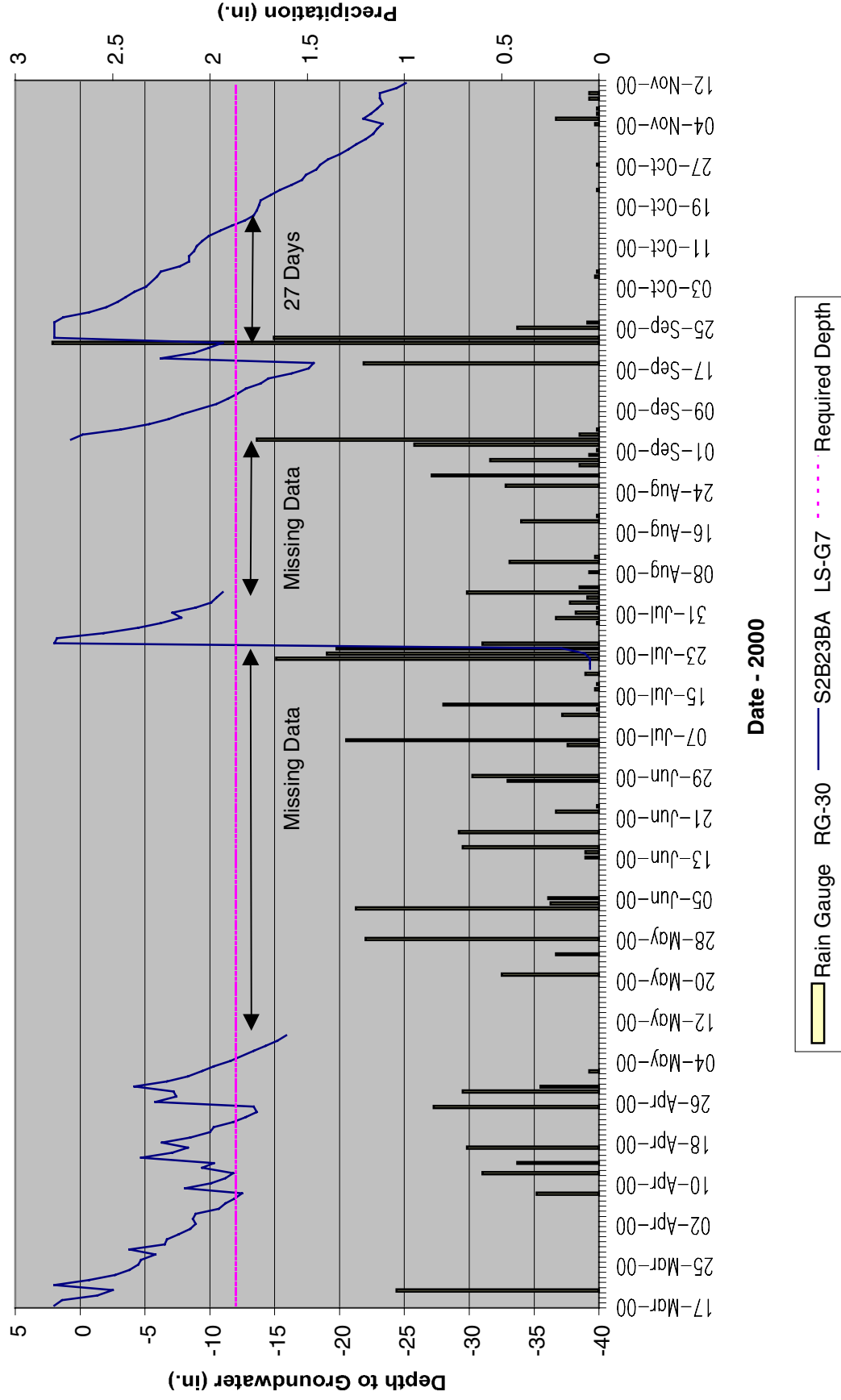


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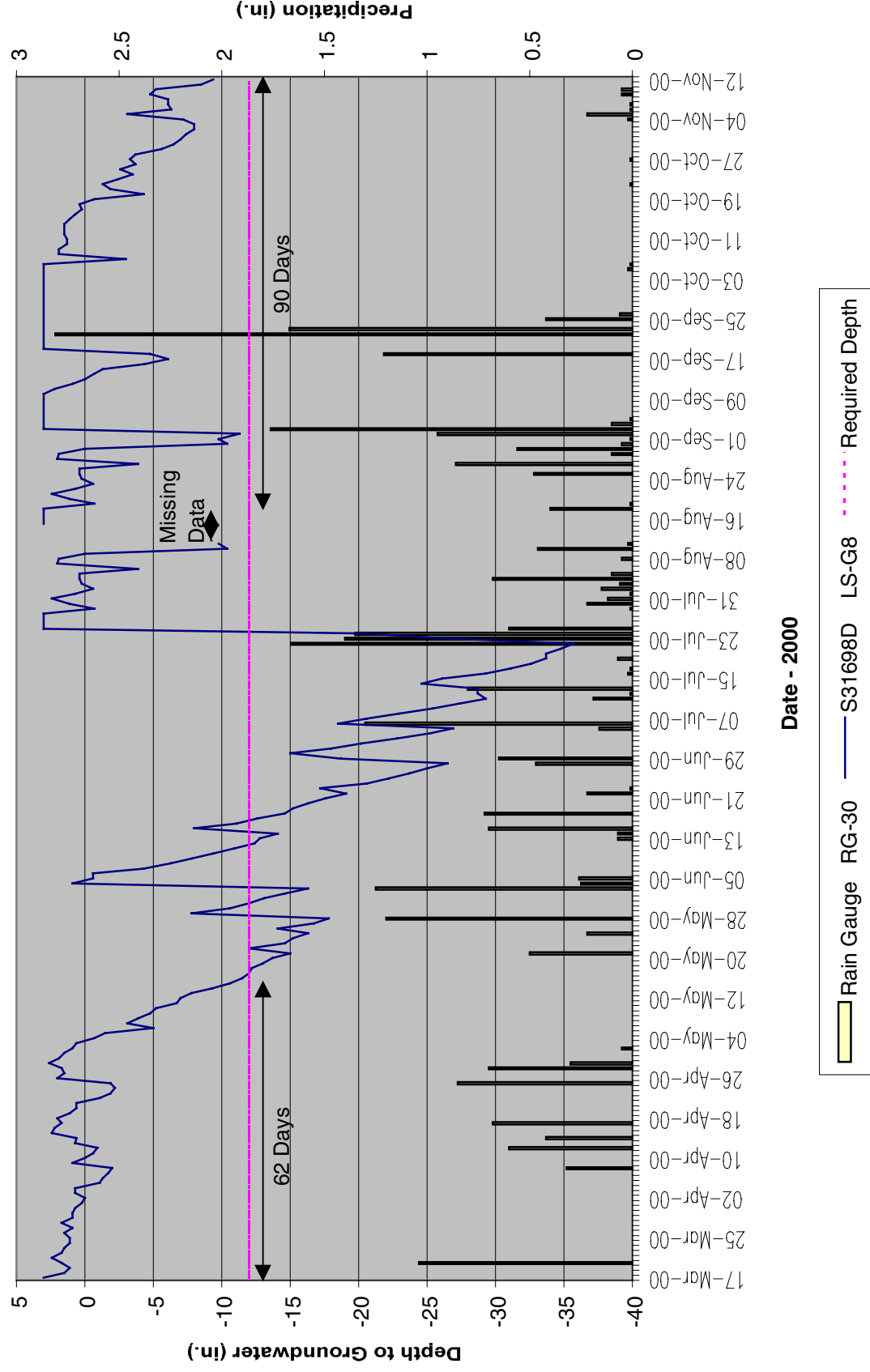




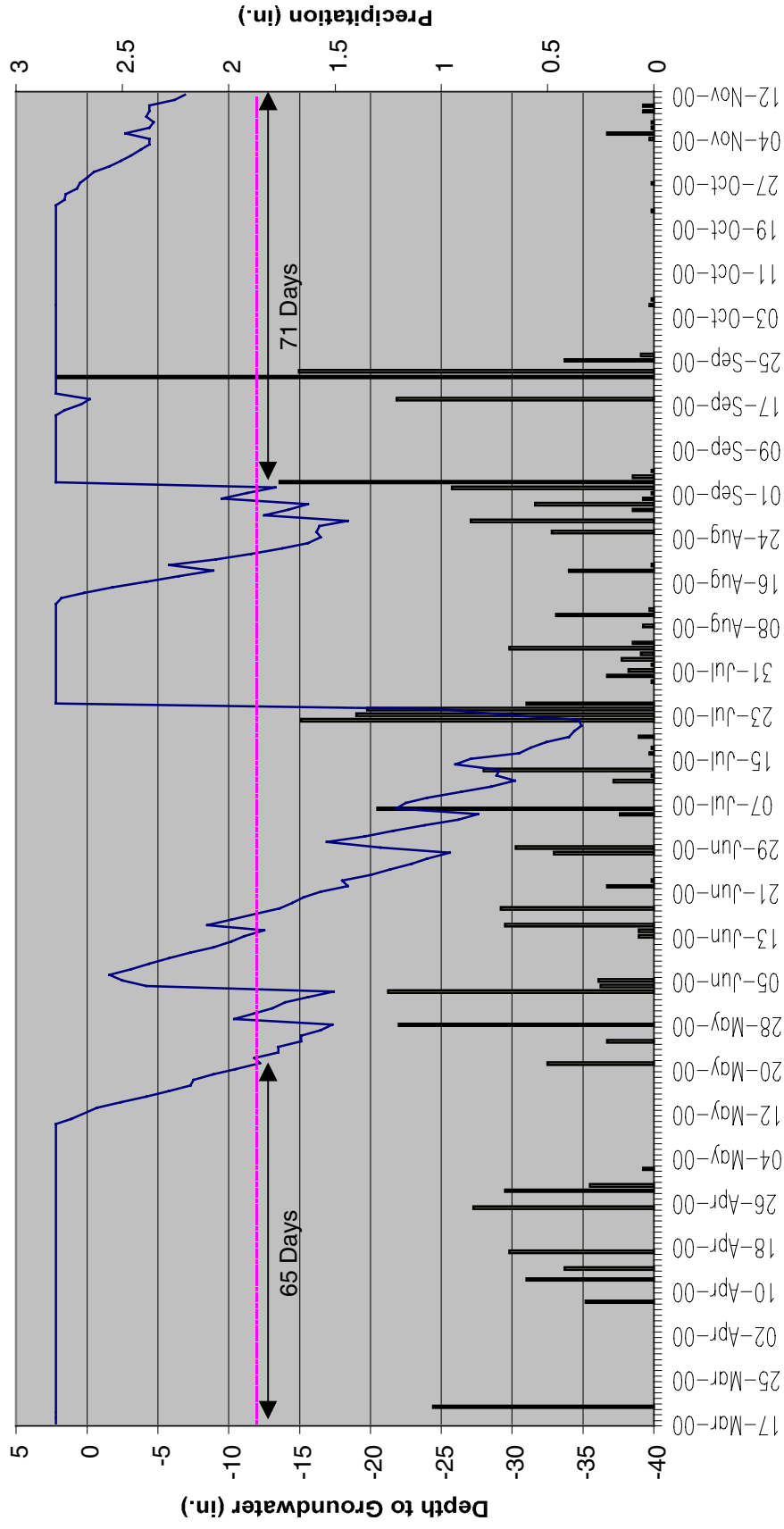
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# Long Swamp - Gauge G8

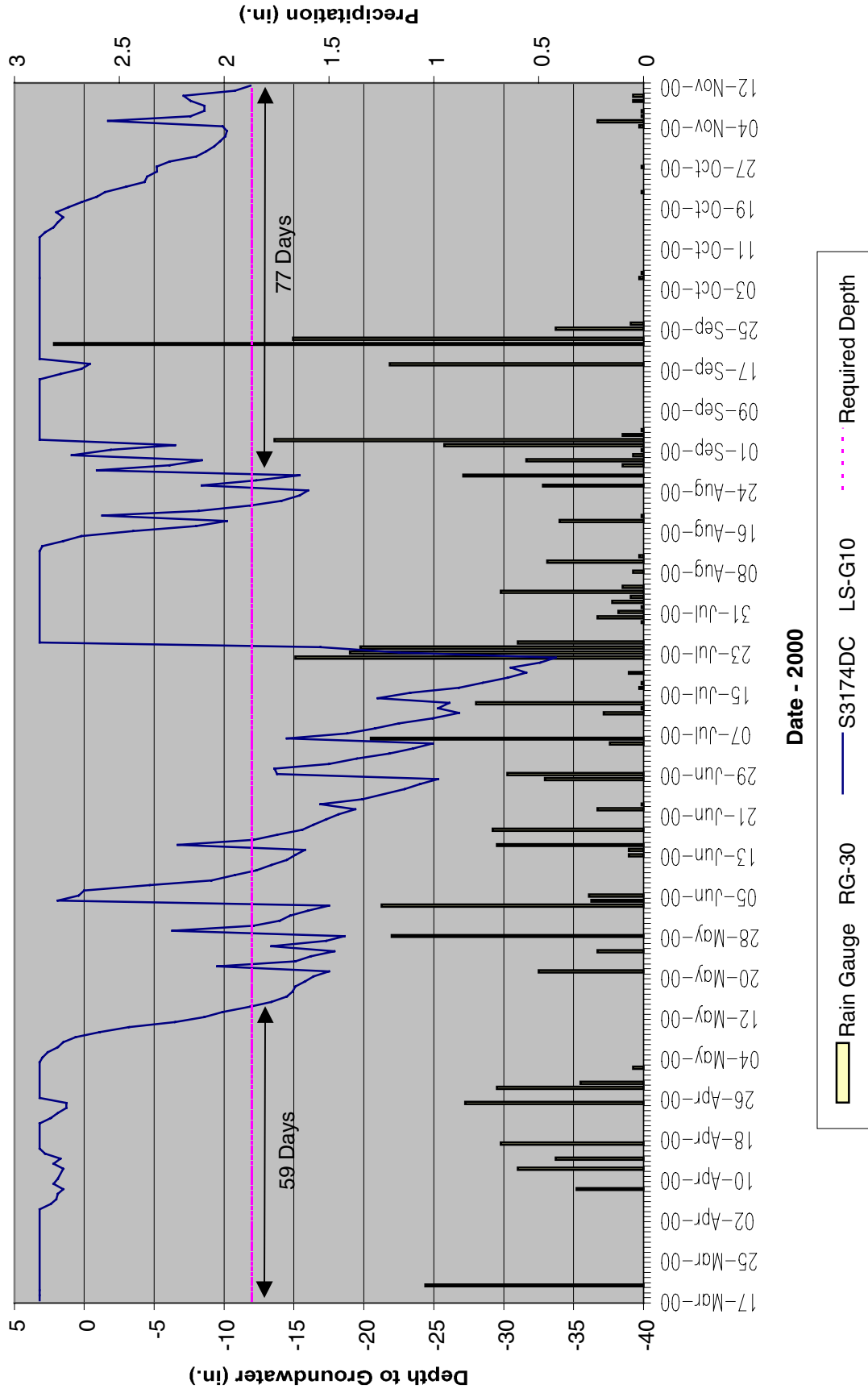


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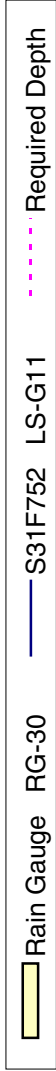
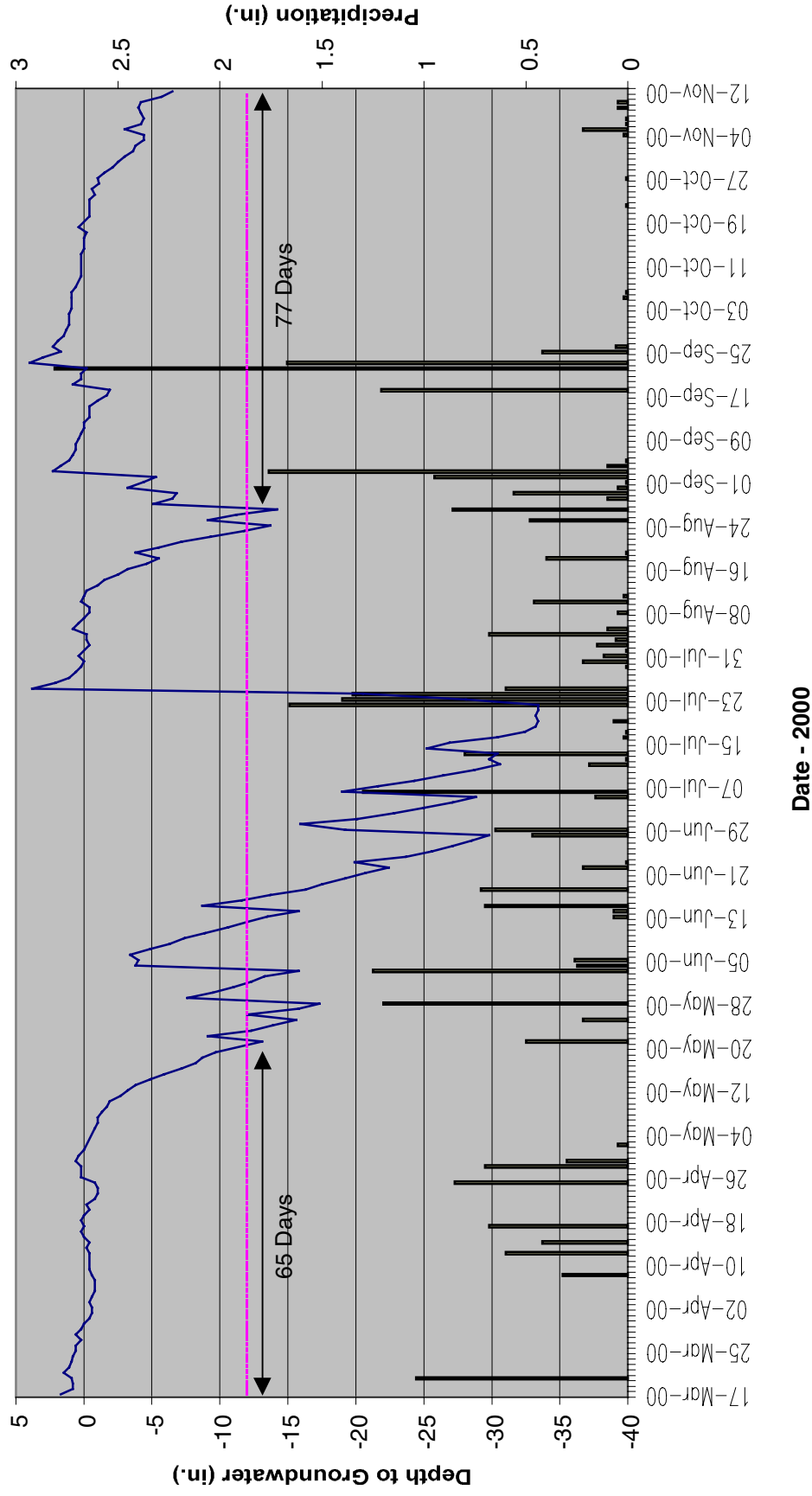


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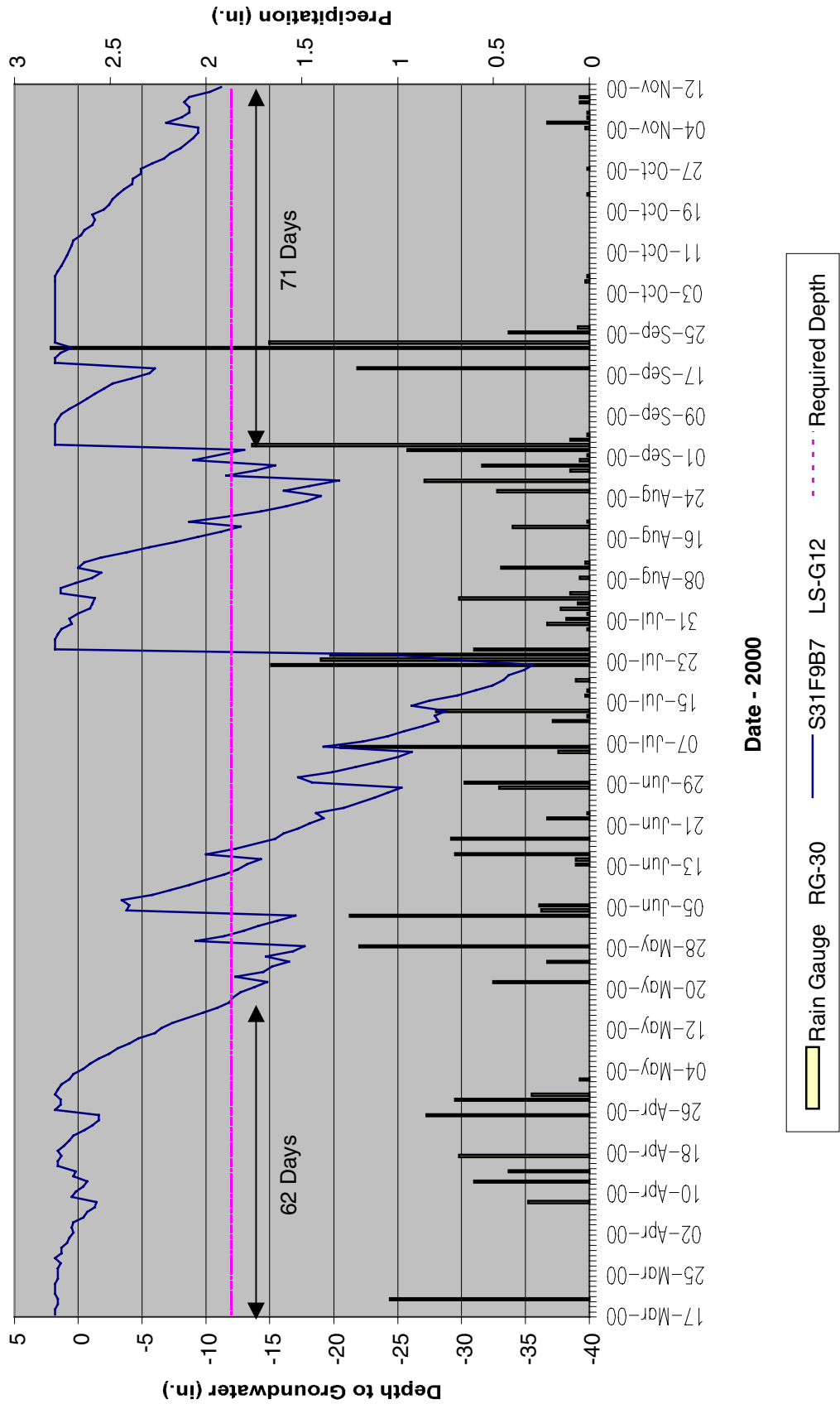
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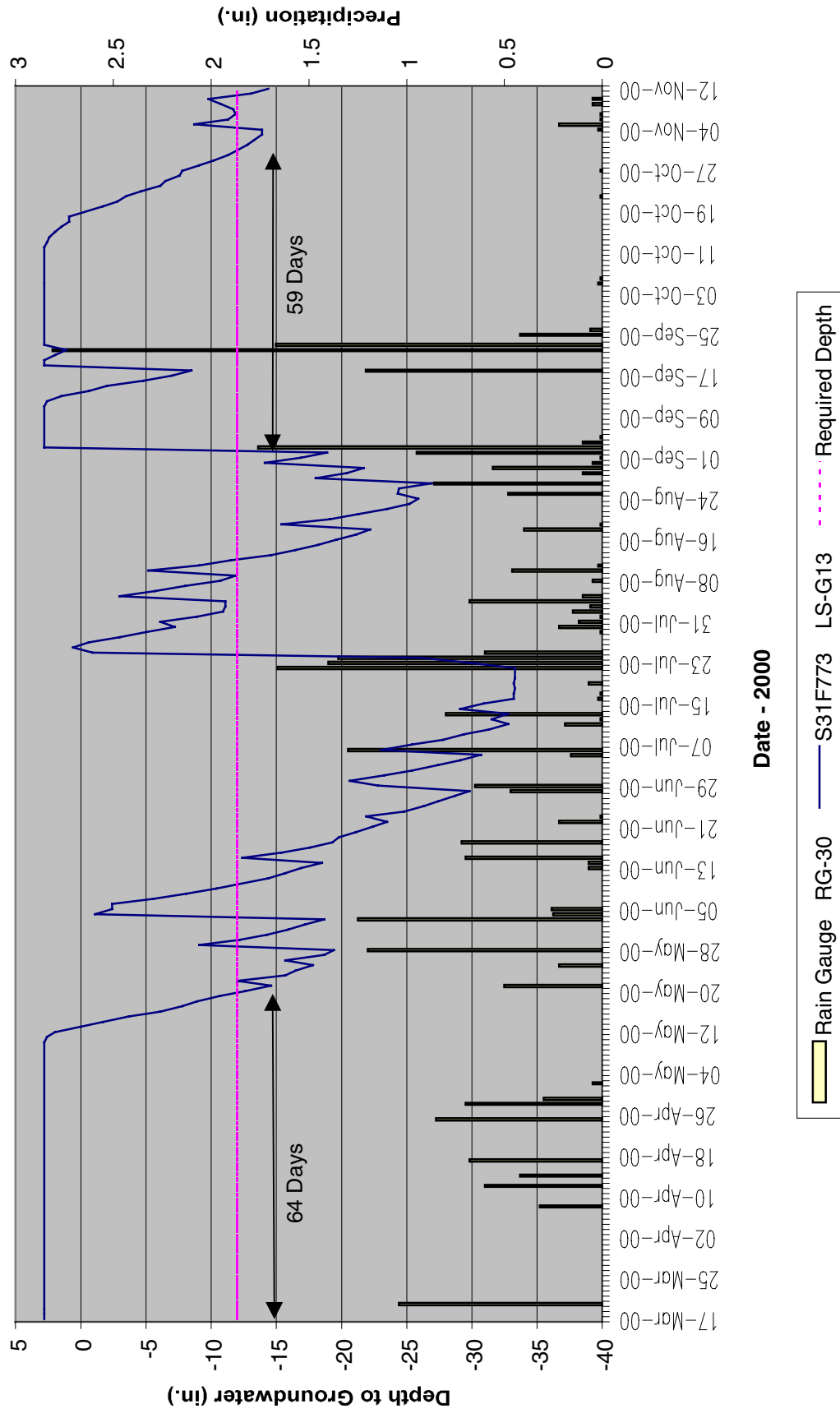
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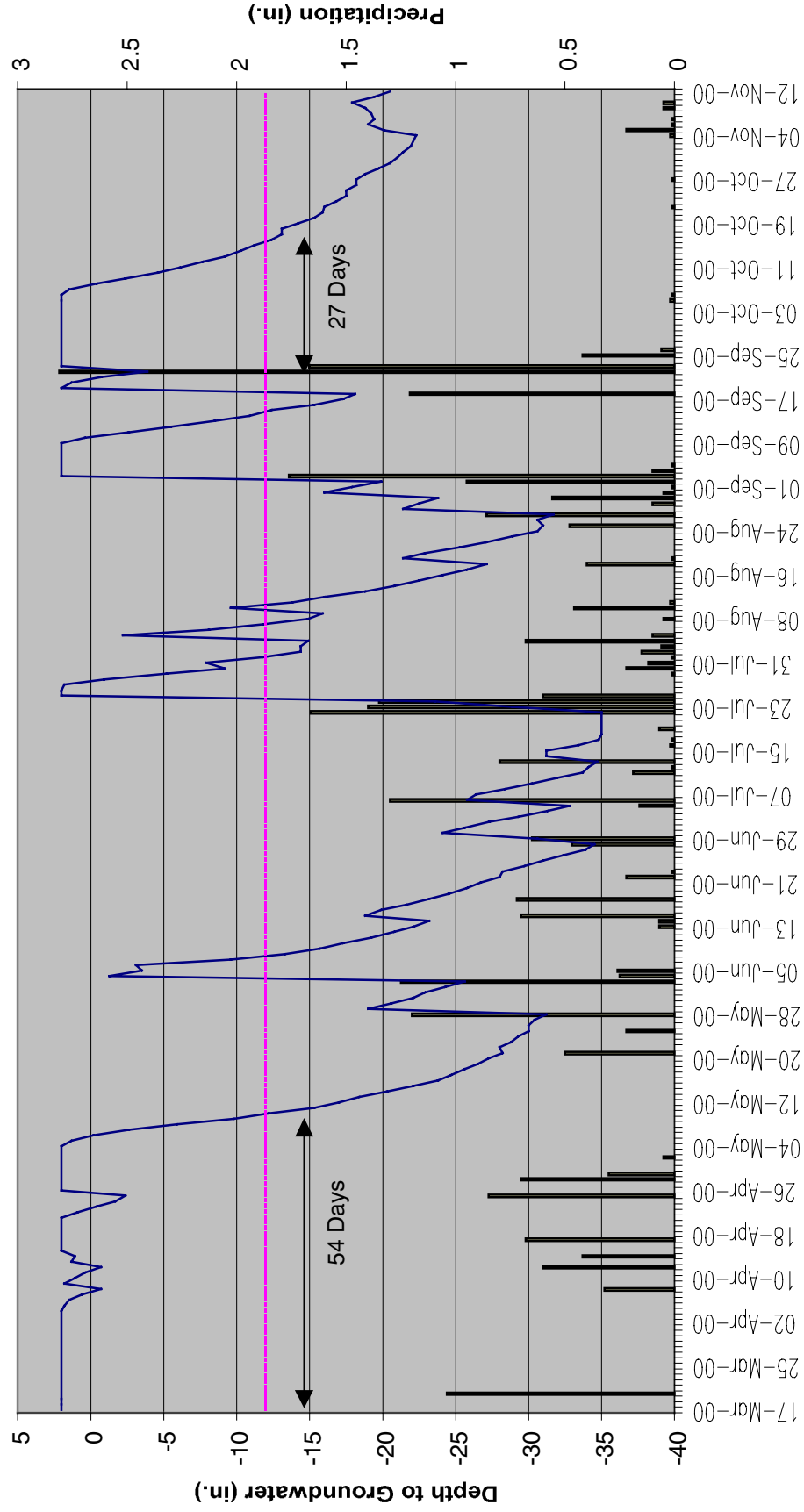
Long Swamp - Gauge G12



# Long Swamp - Gauge G13



# Long Swamp - Gauge G14

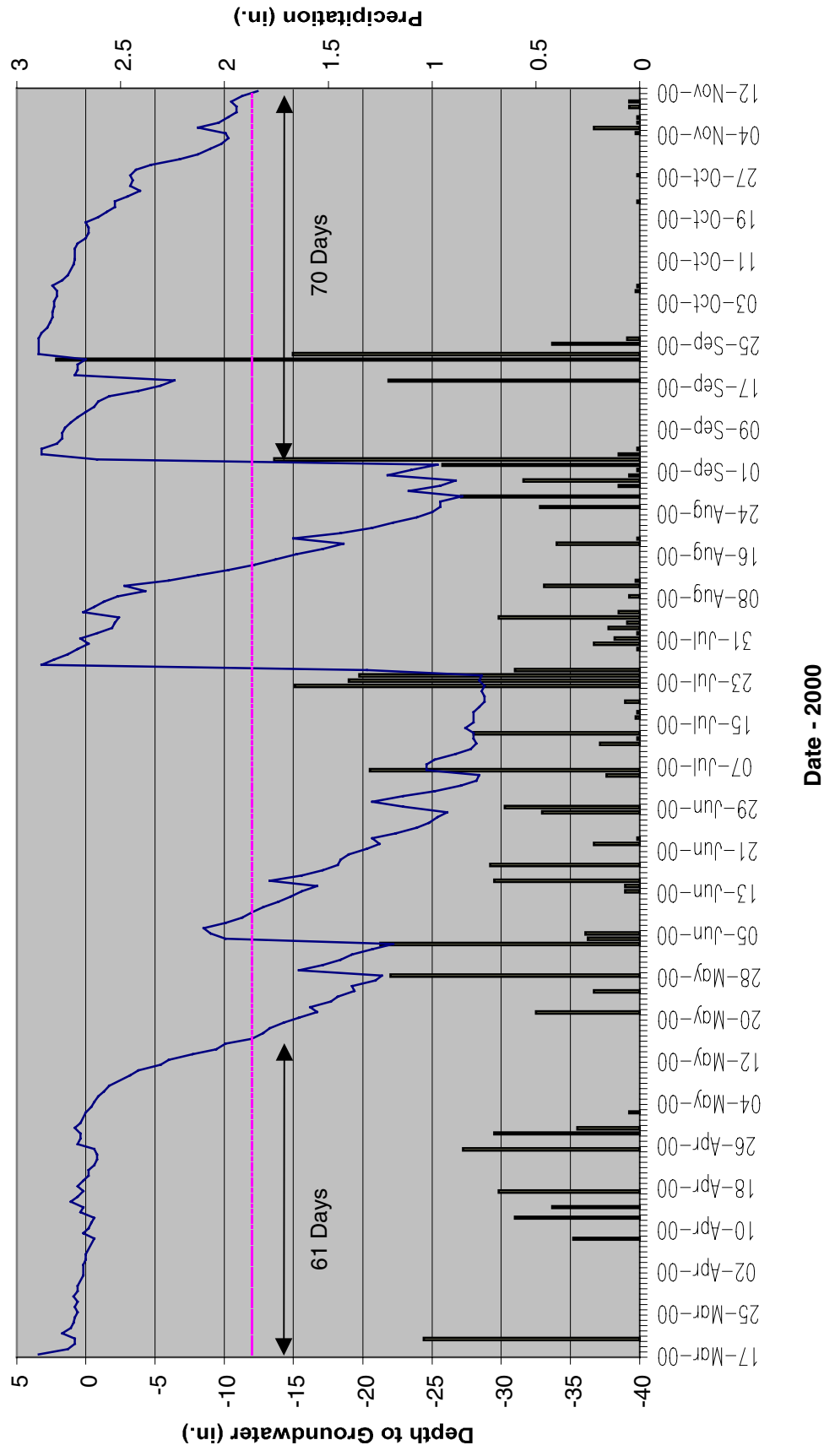


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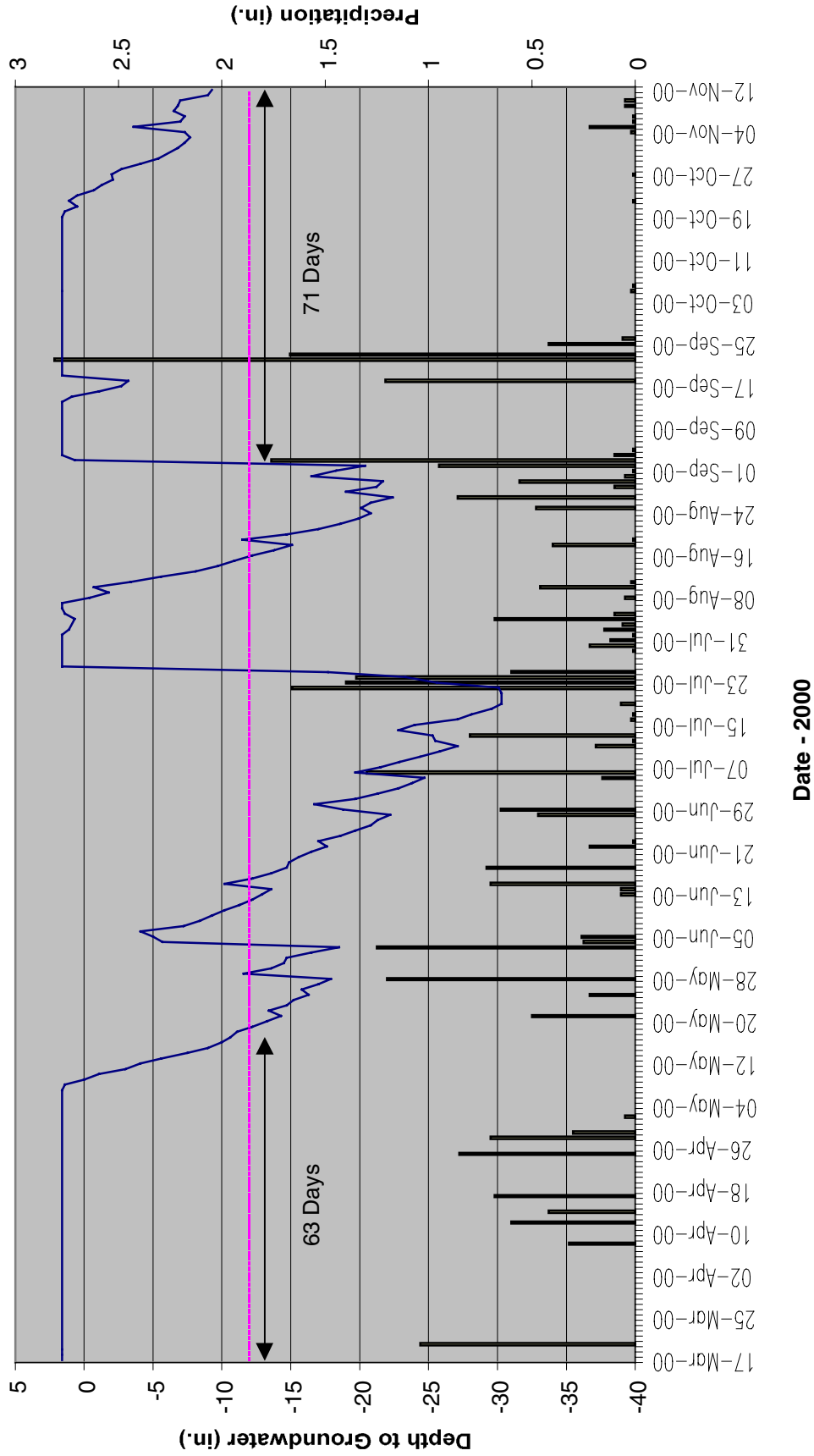
Rain Gauge RG-30 S214055 LS-G14 Required Depth



# Long Swamp - Gauge G15



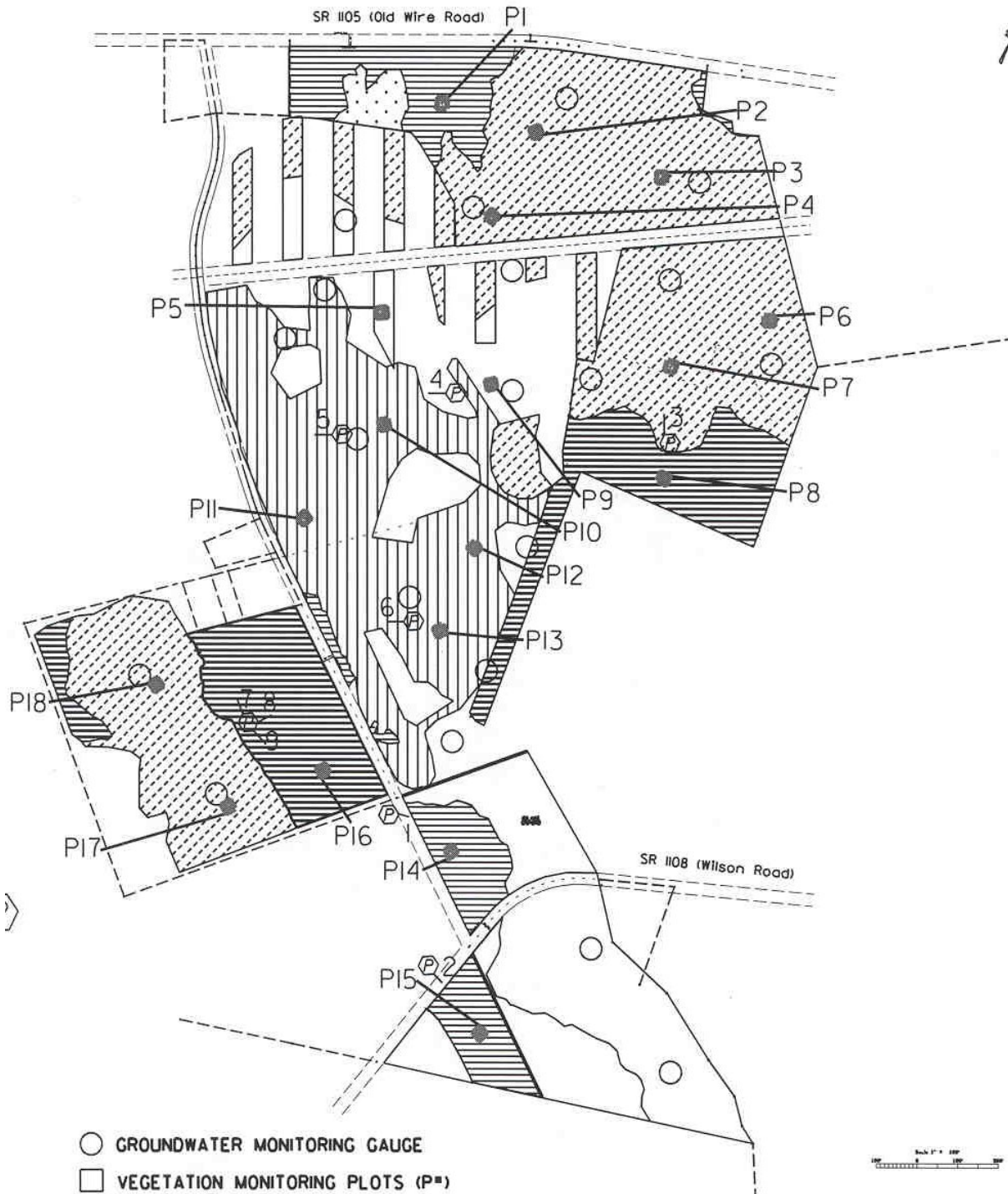
# Long Swamp -Gauge G16



## **APPENDIX B**

### **PHOTO AND VEGETATION PLOT LOCATIONS, SITE PHOTOS**

# LONG SWAMP MITIGATION SITE PLANTING PLAN, VEGETATION PLOTS, PHOTO LOCATIONS





# Long Swamp



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6



# Long Swamp



Photo 7



Photo 8



Photo 9